

**REPORT OF
RAINFALL EVENT,
SEPTEMBER 22-25, 1983
NORTH AND WEST
PALM BEACH COUNTY**

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NORTH AND WEST PALM BEACH COUNTY**

**Water Resources Division
Resource Planning Department**

**Operations Division
Resource Operations Department**

**Field Engineering Division
Resource Control Department**

South Florida Water Management District

October 1983

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HYDRO METEOROLOGICAL ANALYSIS

I. Description

For the second time in less than a year (the previous event was a rainstorm on November 8-9, 1982), residents of Jupiter Farms experienced flooding resulting from a total rainfall of over 10 inches in a 24 hour period. The roads in Jupiter Farms, Palm Beach Country Estates, and Royal Palm acreage area were flooded and remained impassable throughout the night of September 24, 1983. Several thousand homes in the Wellington area, according to Florida Power and Light Company, were without power for three hours in the morning of September 24, 1983.

The morning of September 22, 1983, the cold front resulting from a high pressure system with its center located in the State of Pennsylvania, was just to the north of West Palm Beach, on a line approximately across the Vero Beach/Ft. Myers line. However, the frontal zone was a "mixed bag" as it worked its way south rainfall amounts varied widely, ranging from one to two inches in several locations of Martin and Palm Beach Counties.

In the morning of September 23, between the cold front over the Palm Beach/Martin County area, a minor impulse of moist, warm air coming through from the west (Gulf of Mexico), a small tropical wave (tropical disturbance) coming through the Caribbean, and the setting up of the easterly flow from the high pressure system, very confusing weather conditions existed over the entire south Florida peninsula. The prevailing wind recorded at Palm Beach International Airport on September 23, was 29 miles per hour (mph) in a northeasterly direction. On September 24, this prevailing wind increased to 33 mph. The intensive rainfall started during the evening of September 23 and was over at

approximately 3 p.m., September 24. The stationary front did not stay in the area throughout September 25, as forecasted, and the system generated only a small amount of rainfall in some areas during September 25, before the entire frontal system was over the Florida Keys.

Flood conditions in the West Jupiter Development were reported to the District by residents, subsequent to the rainfall occurring September 24. Reports indicated flooding occurred throughout this development and adjacent areas. Complaints received described lot and road flooding with water levels making some roads impassible. No complaints were received of house flooding and no major problems were reported in the operation of the C. and S. F. system.

II. Rainfall Distribution

The rainfall due to this frontal activity began the evening of September 22, and was on and off throughout September 24. Intensive rainfall occurred between the evening of September 23 and the morning of September 24. The rainfall readings for this storm event were spread out from three to five days due to some rainfall gauges not being read until Monday, September 26. Table 1 shows the daily rainfall values at selected locations.

C-18 basin received the highest rainfall amount during the rainstorm of September 22-24. A total of 12.55 inches of rainfall was reported at the Pratt & Whitney station, and 11.29 inches at the Jupiter Fire Station West, located in the Jupiter Farms area. Royal Palm acreage located in Royal Palm Village, north of Okeechobee Boulevard and the northern Loxahatchee Grove received about 7.5 to 9.0 inches of rainfall, which was the second highest intensive rainfall area. The City of West Palm Beach

received from 4.5 to 8.00 inches; Lake Worth, Greenacres City, and south Palm Beach County received 2.5 to 4.0 inches. The Everglades Agricultural Area and Lake Okeechobee received about 1 to 3 inches. The Kissimmee Basin received less than 1 inch in most areas except S-65C, which received 2.41 inches.

Figure 1 shows the isohyetal map of rainfall distribution resulting from this rainstorm in St. Lucie, Martin, and Palm Beach counties. C-18 basin received a total rainfall of 8 to 12.55 inches during this storm event. This is equivalent to a return frequency between 1 in 10 and 1 in 25 years. The 9.5 inches of rainfall recorded at Pratt & Whitney on September 24 is equivalent to a 1 in 25 year return frequency. Even though this event was not a record rainfall for the area, it was, however, more intense and covered a larger area than the rainstorm of November 8-9, 1982. (See Figure 2.)

The hourly rainfall distribution at four recording stations in the affected area is shown in Figure 3. They are the St. Lucie Lock, Jupiter Fire Station West, West Palm Beach Field Station, and S-5A. The spatial and time variation in rainfall intensity at these four locations is apparent. For example, at the St. Lucie Lock, the rainfall occurred primarily in two separate periods and at the Jupiter Farms area on three separate periods ranging from the evening hours of September 23, and the morning hours of September 24.

There were four separate periods of rainfall recorded at the West Palm Beach Field Station. The most intensive rainfall occurred at 1800 and 1900 hours of September 22; 1500 hours, September 23, and 1 a.m. September 24. The rainfall was then fairly steady throughout the entire morning of September 24.

The rainfall recorded at S-5A was much less in intensity and occurred in four separate periods also.

TABLE 1

DAILY RAINFALL VALUES AT VARIOUS LOCATIONS
PRIOR TO RAINSTORM OF SEPTEMBER 22-25, 1983

Station Name	9/19	9/20	9/21	9/22	9/23	9/24	9/25	9/26	Reading Time
Upper and Lower East Coast									
Ft. Pierce Field Station	1.25A	1.44	0.04	0.35	1.70	X	X	2.36A	7:25 a.m.
Kay-One Grove	0.50	0.00	0.00	0.00	1.50	1.20	0.50	0.00	8:00 a.m.
Hobe Grove	0.20	0.00	1.65	1.00	0.75	0.00	0.00	1.00	6:30-7:00 a.m.
Circle T Grove	0.00	0.18	0.00	1.00	0.00	3.15	0.00	0.00	7:00 a.m.
Stuart 1N	0.03	0.04	0.05	0.04	1.37	1.32	0.08	0.30	Midnight
St. Lucie Lock	0.02	1.48	0.00	T	1.24	0.27	1.92	0.04	8:00 a.m.
Port Mayaca Lock	1.02	0.05	0.00	0.19	0.00	1.45	0.89	T	8:00 a.m.
Jupiter Fire Station	0.05	0.18	T	0.00	0.65	2.60	3.60	T	8:00 a.m.
Jupiter West	0.41	0.00	0.03	0.59	4.50	6.20	0.00	T	Midnight
15 Palm Point Dr. (Jupiter)	X	X	1.97A	0.13	1.58	1.97	4.45	0.02	7:00 a.m.
Pratt & Whitney	0.10	0.00	0.00	2.20	0.85	9.50	0.00	0.55	Midnight
419 Sequoia Dr. (WPB)	0.17	0.47	0.09	0.01	1.20	2.70	0.95	0.03	7:30 a.m.
374 LaMancha Ave. (Royal Palm Beach)	0.52	0.11	0.02	X	2.25A	4.65	1.30	0.01	7:00 a.m.
West Palm Beach Fld. Station	0.26	0.12	0.00	1.82	2.80	4.20	0.00	0.00	Midnight
West Palm Beach Airport	0.14	0.21	0.00	1.28	1.80	3.40	0.06	0.09	Midnight
178 Drawdy Rd. (WPB)	0.38	X	0.07A	0.00	1.75	3.99	0.01	T	6:00 p.m.
Loxachatchee	0.78	0.11	0.00	0.00	3.19	3.32	0.06	0.00	5:00 p.m.
S-5A	0.68	0.01	0.90	0.95	0.41	2.51	0.00	0.09	Midnight
4444 Regency Dr. (LW)	0.10	0.06	0.13	T	0.05	X	2.54A	0.02	8:00 a.m.
Greenacres City	1.15A	0.10	0.25	0.00	0.03	X	X	3.20A	8:00-12:00 a.m.
Lake Worth & E1	0.73A	0.15	0.05	0.00	0.06	X	X	4:15A	8:00-12:00 a.m.
Delray Rd. & E2	2.28A	0.05	0.05	0.05	0.00	X	X	3.62A	8:00-12:00 a.m.
Boca Rd. & Range Line	2.00A	0.35	0.15	0.50	0.00	X	X	2.90A	8:00-12:00 a.m.
Margate	2.00	1.04	0.05	1.90	X	X	X	1.42A	9:00 a.m.
Ft. Lauderdale Fld. Station	1.25A	1.44	0.04	0.35	1.70	X	X	2.36A	8:00 a.m. Callary- Judge Grove N/A N/A N/A2.504.902.400.000.00
East Everglades Agricultural Area									
Hurricane Gate 5 (HGS-5)	1.12	0.16	0.03	0.00	0.07	0.00	1.00	0.00	8:00 a.m.
East Beach	0.09	0.03	0.10	0.41	0.13	0.02	0.26	N/A	7:00-9:00 a.m.
Pelican Lake	1.58	0.02	0.14	0.17	0.09	0.41	0.64	N/A	7:00-9:00 a.m.
Belle Glade Exp. Station	1.20	0.46	0.06	0.00	0.70	1.84	0.43	0.00	Various

Table 1-continued

Station Name	9/19	9/20	9/21	9/22	9/23	9/24	9/25	9/26	Reading Time
Lake Okeechobee									
H6S-4	1.62A	0.37	0.32	0.00	0.90	X	X	0.65A	8:00 a.m.
S-131	0.23	0.00	0.00	0.43	0.10	0.60	0.00	0.00	Midnight
S-129	0.94A	0.00	0.00	0.08	0.12	X	X	0.62A	8:00 a.m.
S-127	1.00A	0.03	0.00	0.27	0.07	X	X	1.27A	8:00 a.m.
S-133	0.37A	0.10	0.00	0.97	0.03	X	X	0.48A	8:00 a.m.
S-3	0.36A	0.03	0.00	0.44	0.14	X	X	0.45A	7:00 a.m.
S-135	0.28A	0.08	0.06	0.48	0.00	X	X	3.71A	8:00 a.m.
Kissimmee Lakes & Valley									
Kissimmee Fld. Station									
S-61	2.26A	0.30	0.10	0.00	0.03	X	X	0.00A	8:00 a.m.
S-65	1.15A	1.33	0.37	0.00	0.15	X	X	0.00A	8:00 a.m.
S-65A	2.36A	0.88	0.00	0.00	0.04	X	X	0.00A	8:00 a.m.
S-65B	0.05A	1.12	0.24	0.21	0.26	X	X	0.07A	8:00 a.m.
S-65C	0.00A	0.00	0.00	0.00	1.05	X	X	0.00A	8:00 a.m.
S-65D	0.20A	0.00	0.23	0.28	1.85	X	X	0.28A	8:00 a.m.
S-65E	0.35A	0.00	0.00	1.00	0.10	X	X	0.00A	8:00 a.m.
S-68	0.66A	0.00	0.00	0.10	0.12	X	X	0.30A	8:00 a.m.
	0.20A	0.00	0.00	0.00	0.10	X	X	0.00A	8:00 a.m.

Notes: A = Accumulation
 X = Value accumulated on the following day
 T = Trace
 N/A= Not available

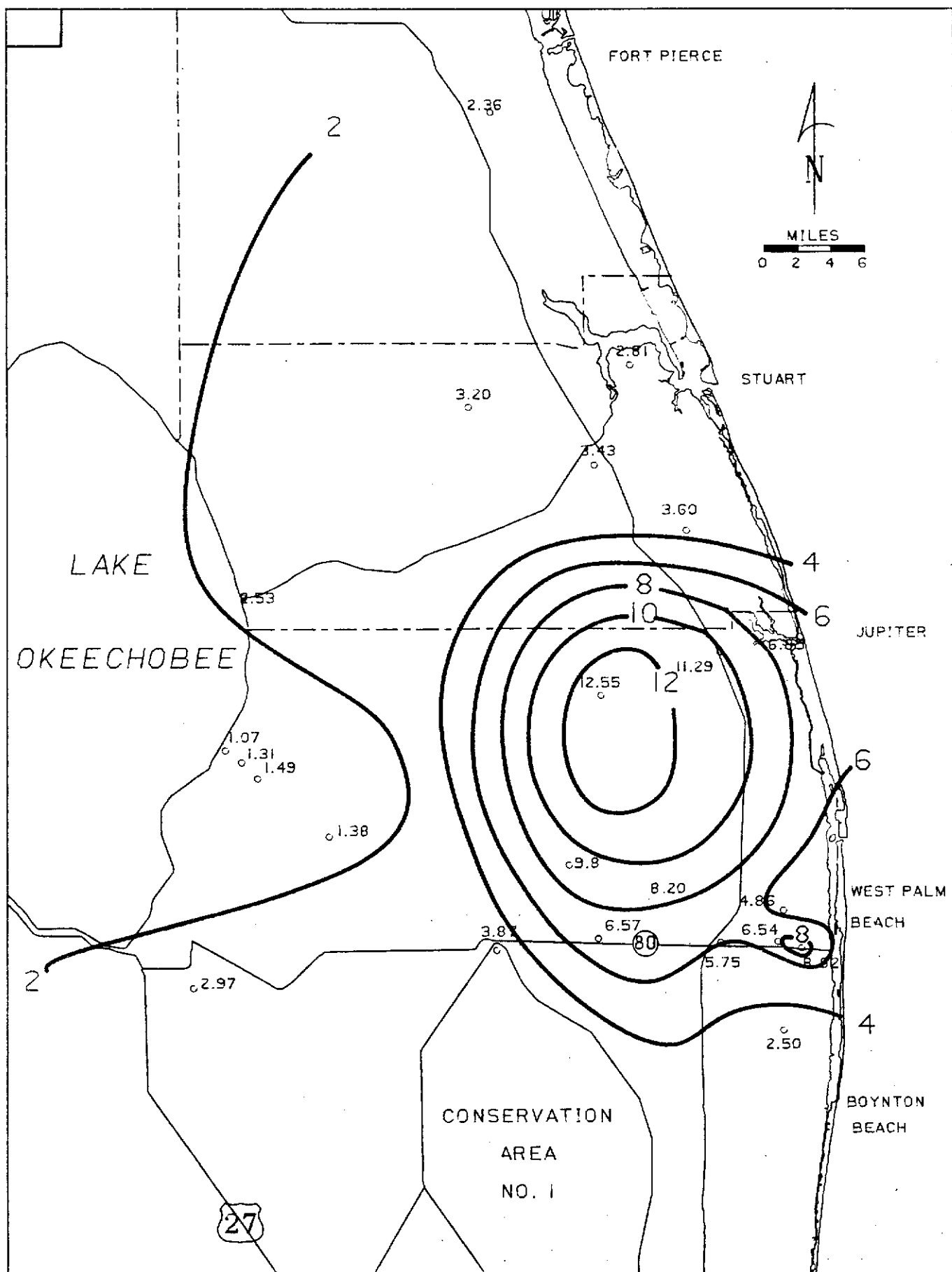


FIGURE 1
ISOHYETAL MAP OF SEPTEMBER 22 - 25, 1983 STORM
IN PALM BEACH AND MARTIN COUNTIES

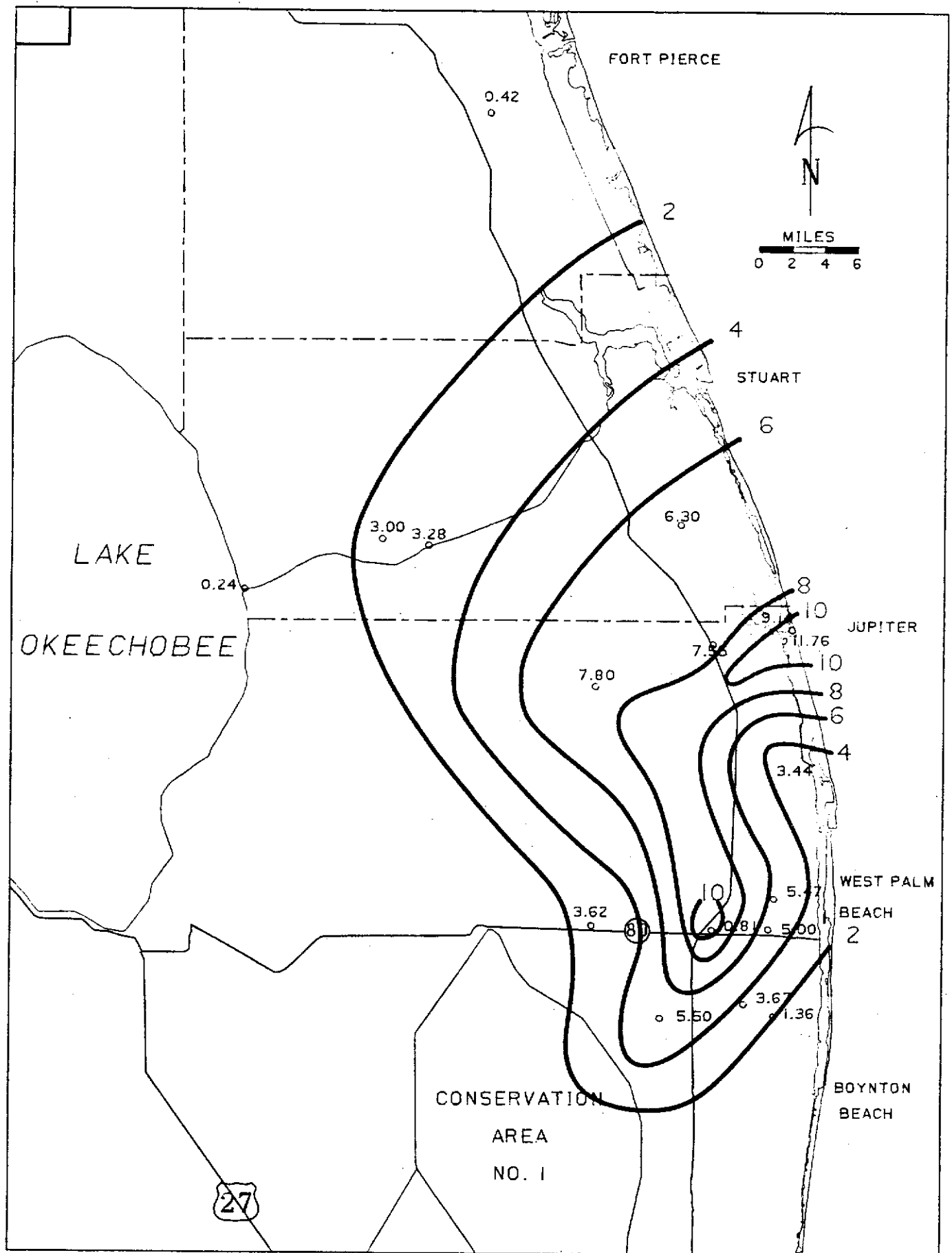
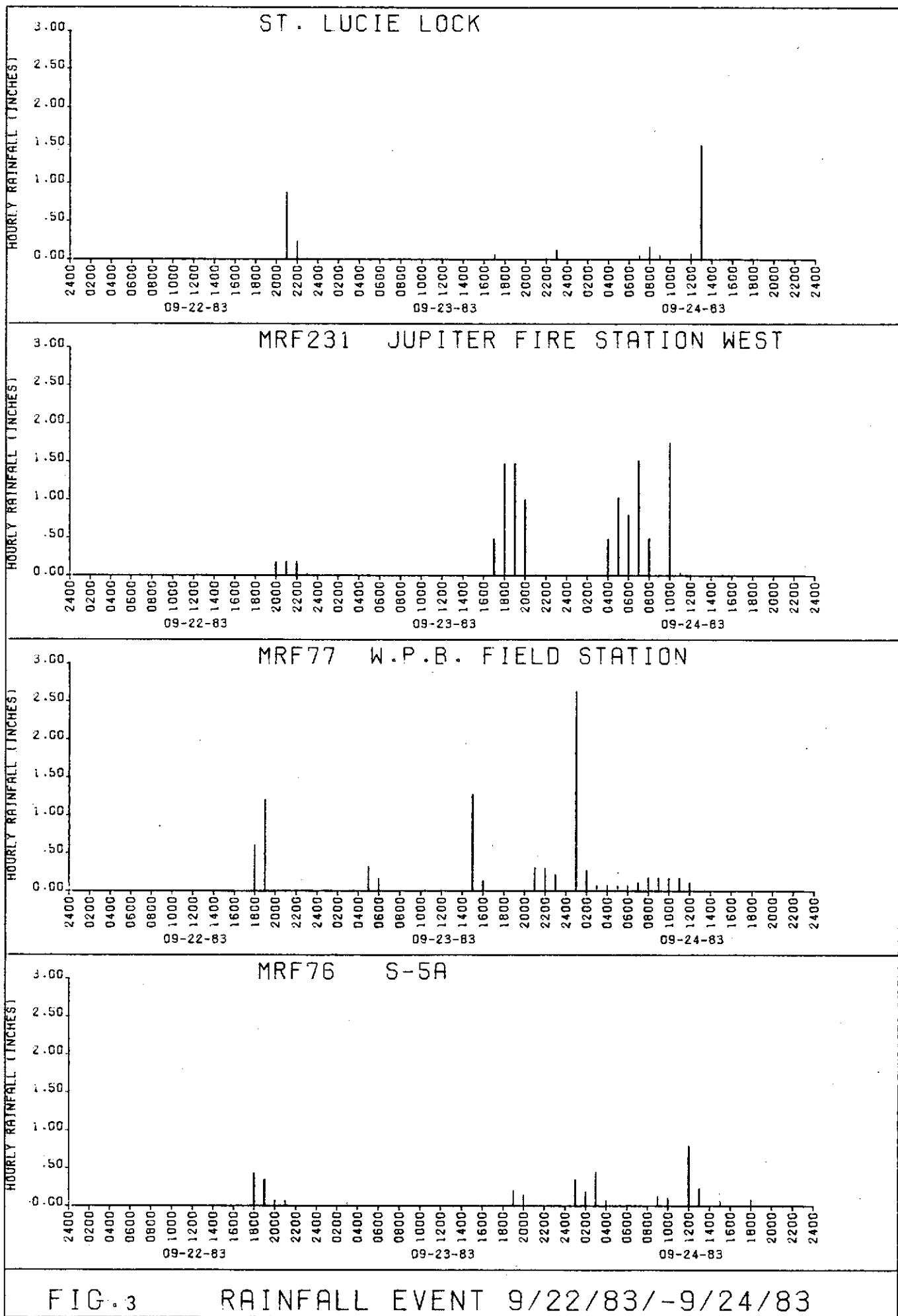


FIGURE 2
ISOHYETAL MAP OF NOVEMBER 7 - 10, 1982 STORM
IN PALM BEACH AND MARTIN COUNTIES



III. Antecedent Conditions

A. Rainfall

According to the National Weather Service, the total rainfall this year through September 22 was 56.41 inches as compared to the normal of 44.0 inches. The afternoon showers had been active throughout the District area for the week prior to September 22 (see Table 1). The total rainfall at various locations for the period of September 19-21 was between 0.5 and 2.50 inches. This amount of rainfall provided a fairly wet moisture condition prior to the storm. This, in general, produced a higher runoff for the same amount of rainfall. There were some discharges at the coastal structures, such as S-46, S-44, S-41, Palm Beach Lock, etc., during this antecedent period.

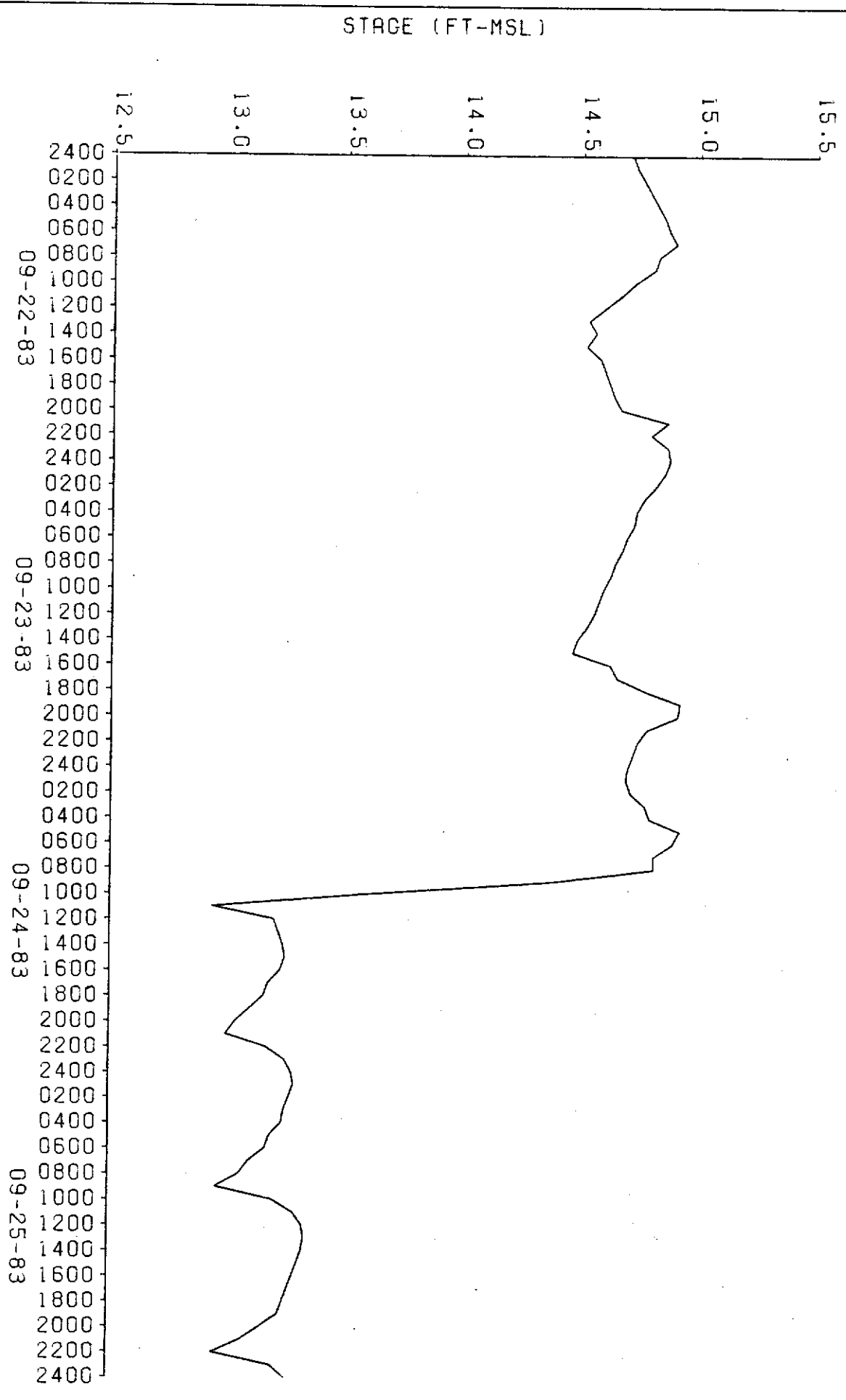
B. Canal Stages Prior to the Storm

Since the greatest amount of rainfall occurred in the C-18 and western C-51 basins, the water level conditions in these areas were examined. The following table shows the water levels on September 22 as compared to their optimum stages.

TABLE 2
The Water Levels September 22, 1983 as Compared
to Their Optimum Stages

<u>Structure</u>	<u>Headwater Stage Ft NGVD</u>	<u>Current Optimum Stage-Ft NGVD</u>	<u>Normal Optimum Stage-Ft NGVD</u>
S-46	14.70	14.80	14.50-15.0
L-8 at SR 441	11.75	12.00	12.0
Palm Beach Lock	7.46-7.67	8.00	8.50

FIG. 4 HOURLY STAGE READINGS AT S-46 HEADWATER



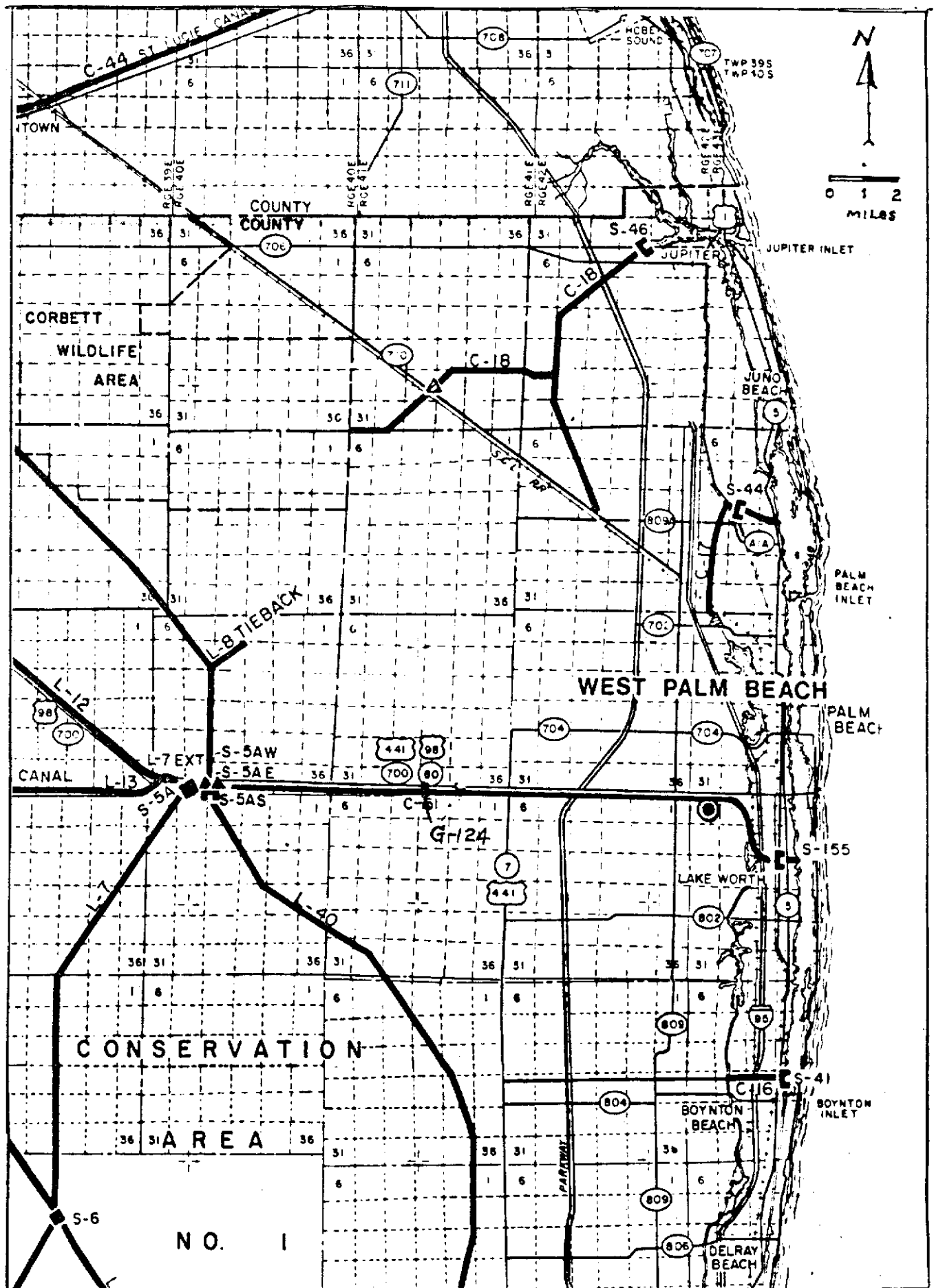


FIGURE 5

OPERATION OF THE SYSTEM

I. Operation of C-18

The control structure (S-46) on Canal 18 is normally operated automatically to maintain a headwater stage between 14.5 and 15.0 ft. During major storm events a special automatic operation is employed which controls the headwater stage between 13.0 and 14.0 ft. A major storm event is defined as one in which the downstream stage at the weir on the west leg of the canal at SR 710 is above the weir crest elevation of 17.6 ft.

On Saturday morning, September 24, 1983, after a heavy rainfall, the downstream stage at the weir was 18.2 ft, consequently, S-46 was placed on the lower setting at 8:30 a.m. Before this change, the structure discharge, though still rising, had reached 2,250 cfs. After the change, the discharge rose to 4,300 cfs, and then gradually decreased to 2,055 cfs by 11:30 a.m. on Monday, September 26. At that time the stage at the weir had dropped below the crest (17.1 ft) so S-46 was returned to the normal 14.5 to 15.0 ft setting. (See Figure 4 for hourly stage hydrograph at S-46).

This change resulted in the gates closing for about an hour as the canal refilled, rising from 13.25 to 15.0 ft. Thereafter, the gates again opened and initially discharged 1,800 cfs. The gate gradually closed and the discharge had fallen to about 600 cfs by Thursday morning, September 29.

Discharges from C-18 were also made through a diversion culvert (G-92) in addition to those through S-46. The diversion culvert is operated by the Loxahatchee Environmental Control District (Encon). The normal

function of this culvert is to provide supplemental flows to the northwest fork of the Loxahatchee River.

On Friday, September 23, the 54 inch diameter culvert was open 1.5 ft, and the discharge from C-18 was about 30 cfs. Saturday on the "normal" downstream, or north side of the culvert, the water had risen above the stage in C-18 and discharge was occurring into C-18. The staff gage, however, was under water, so the discharge could not be calculated. On Tuesday, when our water reader visited the site, he found that the gate on the culvert had been closed, even though the canal (C-18) stage was lower than the stage to the north. This condition existed until Thursday, September 29, when the stage to the north dropped below the C-18 stage.

The area which flooded during and after the storm of September 23-24 is not in the drainage basin of C-18. Any flood relief which can be provided by C-18 is only incidental, and C-18 cannot be operated in order to provide this benefit to the area outside the normal basin.

Even if such flood control benefits were provided, they would be of marginal value at best. The maximum discharge from the area into C-18, had the canal stage remained low and the culvert gates fully opened, would have been at best only about 100 cfs.

This flow would have been very small compared with the natural discharge to the north beneath the Indiantown Road bridge, which was measured by the USGS on September 25 as 1,060 cfs, and by the SFWMD on September 26 as 990 cfs. (These values are preliminary and subject to revision.)

II. Operation of C-51

The District has three control structures on the C-51 canal: S-5AE at the extreme west end, G-124 about six miles to the east of S-5AE, and G-55 (Palm Beach locks) which discharges to tidewater. (See Figure 5).

Palm Beach locks consists of two structures in parallel--a gated spillway and an eight barrel box culvert controlled by stop logs. The gate is operated automatically between headwater elevations of 7.3 and 8.0 ft as long as the flow does not exceed the capacity of the structure. Larger flows are discharged by manipulation of the culvert stop logs. During the storm, the structure controlled the headwater stage between 7.2 and 8.0 ft; therefore, no problems were encountered in the eastern portion of the basin.

The structure, G-124, is a six barrel culvert with two barrels gated and four barrels with stop logs. All but one barrel (which creates erosive currents adjacent to SR-80 when open) remained full opened throughout the storm.

Flow through the structure could not be determined because the upstream staff gage was submerged, but visual observations indicated little or no flow through the structure as water levels were the same on both sides. The hourly stage hydrographs recorded at S-5AE and Wellington Road (see Figures 6 and 7) indicated that the water level in C-51 might be peaked at this structure.

Structure 5AE is a double barrel culvert which remained open throughout the flood period. Flow was eastward from the L-8 canal until 5 a.m. on September 24, when the flow ceased; at 6 a.m. S-5AW, an identical structure, was opened and flow from C-51 and L-8 was diverted

to the west and was pumped by the District's pumping station S-5A into Water Conservation Area 1. (See Figures 8 and 9 for hourly stage hydrographs at L-8 and S-5AW at State Road 441)

Heavy gravity and especially pumped inflow into C-51 raised the level in that canal to a very high level from the period of midnight on the 23rd to midnight on the 25th. The peaked stage at 15.2 (measured at S-5AE) at 1 a.m. on September 25. The stage dropped gradually to about 12 at 9 a.m. on September 27. During this entire period, pumping occurred at S-5A.

The operation rationale was to drain L-8 to the east on Friday evening. However, when the head across S-5AE equalized early Saturday, it became apparent that C-51 could not handle the flow; therefore, S-5AW was opened (at 5 a.m.) and as much flow as possible was directed west and pumped by S-5A. Unfortunately, the flow in L-8 limited the discharge flowing westward from C-51, and there does not exist a way to control the L-8 flows. At the peak stage in C-51, the discharge through S-5AE was 650 cfs; and through S-5AW was 1,350 cfs.

No problems occurred as a result of this operation; however, several points need to be made:

1. The peak stage of 15.2 was very close to the minimum crest elevation of the south bank levee of 15.4. Several sections of agricultural land south of this levee lie below elevation 13.
2. The sustained high stages in the western portion of C-51 undoubtedly limited the gravity discharge capacity into it, increased the pumping costs, and decreased the pumping capacity of adjacent installations.

3. Since this area is not in the drainage basin of pump station S-5A, had a heavy rainfall also occurred in the S-5A drainage basin, the S-5AE and S-5AW gates would have been closed, and the C-51 stage would have been considerably higher.

FIELD INSPECTION OF AFFECTED AREAS

I. The West Jupiter Development Area

Flood conditions in the West Jupiter Development were reported to the District by residents, subsequent to the rainfall on September 24, 1983. Reports indicated that flooding occurred throughout this development and adjacent areas. The complaints which were received described lot and road flooding with water levels making some roads impassible. No complaints were received of house flooding.

The West Jupiter area is located in northern Palm Beach County, west of the town limits of the Town of Jupiter. The area of west Jupiter occupies all or parts of 21 sections in T40/R41, T41/R41 and 42. This development is an older, unpermitted development lying predominately within the South Indian River Water Control District.

The West Jupiter Development, South Indian River Water Control District, is divided into roughly three drainage basins, as follows:

Western Basin: Area lying west of C-18

Middle Basin: Area lying east of C-18 and west of the Florida Turnpike

Eastern Basin: Area lying east of the Florida Turnpike

The western basin has internal E-W and N-S canals. Flow in the internal canals is generally from west to east, then northerly under Indiantown Road and into the northwest fork of the Loxahatchee River.

The South Indian River Water Control District has a Conceptual Permit, No. 50-90030-S, from this District, approved August 12, 1982 for the eastern and middle basins. A small temporary pump exists which has been used during emergency flood conditions for discharging into C-18 via

project culverts No. 10. The middle basin and eastern basin are connected at this time by a double 9' x 5' box culvert with invert elevation of 11.8 ft NGVD under the turnpike. A proposal has been submitted at SIRWCD for collecting stormwater from the middle basin and eastern basin and discharging into C-18 downstream of S-46.

II. Flooding and Flood Damages

A. Western Basin

District staff inspected the area on Monday, September 26, 1983, (2nd day after the storm) and observed contract repair crews from the South Indian River Water Control District working on restoring road wash-outs and removing ditch "wash-ins". The western half of the western basin was generally dried out with only small pockets of water standing on property. The eastern half of the western basin still had road wash-outs and standing water. (See Figure 10.)

B. Middle Basin

District staff inspected the area on Monday, September 26, 1983 (2nd day after the storm) and did not see evidence of flooding.

C. Eastern Basin

District staff inspected the area on Monday, September 26, 1983 (2nd day after the storm) and did not see evidence of flooding.

D. Helicopter Inspection

District staff inspected the area on Wednesday, September 28, 1983 (4th day after the storm) and found most of the area to be dried out, only small pockets of standing water were seen. Most roads had been repaired.

III. Summary of Observations

A. West Jupiter Area

The West Jupiter area did experience flooding as a result of the September 24, 1983 storm. Field reports indicated that two days after the storm only the eastern half of the western basin still had standing water. Field reports indicated that four days after the storm, no standing water remained and only isolated ponding remained.

B. Western C-51 Basin

The District did not receive any complaints of flooding from the western C-51 Basin during or after the September 24, 1983 storm. A helicopter inspection on September 27, 1982 of the Tall Pines problem area did not find evidence of flooding.

SUMMARY OF THE RAINFALL EVENT

This rainstorm was basically caused by a strong frontal activity combined with a minor impulse of moist and warm air coming from the Gulf of Mexico, and a small tropical disturbance coming through the Caribbean. The prevailing wind recorded at Palm Beach International Airport on September 23 and 24, 1983, was 29 to 33 mph in a northeasterly direction. The major rainfall began on the evening hours of September 23, 1983, continued through the morning hours of September 24, 1983, and was generally over in the afternoon of September 24, 1983.

Even though, this rainstorm was not very severe, several areas recorded over 10 inches of rainfall in 24 hours such as the Jupiter Fire Station West (11.29 inches) and Pratt & Whitney (12.55 inches). The C-18 basin which is located west of Jupiter and Palm Beach Gardens received a rainfall amount equivalent to a return frequency between 1 in 10 and 1 in 25 years. The 9.5 inches of rainfall recorded at Pratt & Whitney on September 24, 1983 is equivalent to 1 in 25 years return frequency. Other areas affected by the rainstorm were Royal Palm Acreage and Callery Judge Grove that received about 7.5 to 9.0 inches of rainfall. The City of West Palm Beach also received from 4.5 to 8.0 inches. This rainstorm was more intensive and covered a wider area than the rainstorm on November 8-9, 1982, which was primarily concentrated in the coastal area of Jupiter.

As a result of this rainstorm, the roads in Jupiter Farms, Palm Beach Country Estates, and Royal Palm Acreage were flooded and remained impassable throughout the night of September 24, 1983. However, no house flooding was reported.

Review of the operation data at S-5A complex and S-46 at C-18 indicated that the system was operated properly, avoiding potential flooding in the western C-51 basin.

Several points are worthwhile to mention in relation to potential flooding in the C-51 basin:

1. The peak stage of 15.2 from the Sucrose Grove area was very close to the minimum crest elevation (15.4 ft) of the south bank levee. Several sections of sugar cane and citrus land south of this levee lie below elevation 13.
2. Rainfall in the area south of western C-51 canal was less than 4.0 inches; however, had a heavy rainfall also occurred in this area, the flood stage in western C-51 canal would have been higher.
3. Pumping station S-5A was operated during this rainstorm to relieve the flood stage in L-8 and western C-51 by opening structures S-5AE and S-5AW. Had heavy rainfall also occurred in the normal drainage basin of S-5A to the west, the S-5AE and S-5AW gates would have been closed, and the C-51 stage would have been considerably higher with significant flooding.

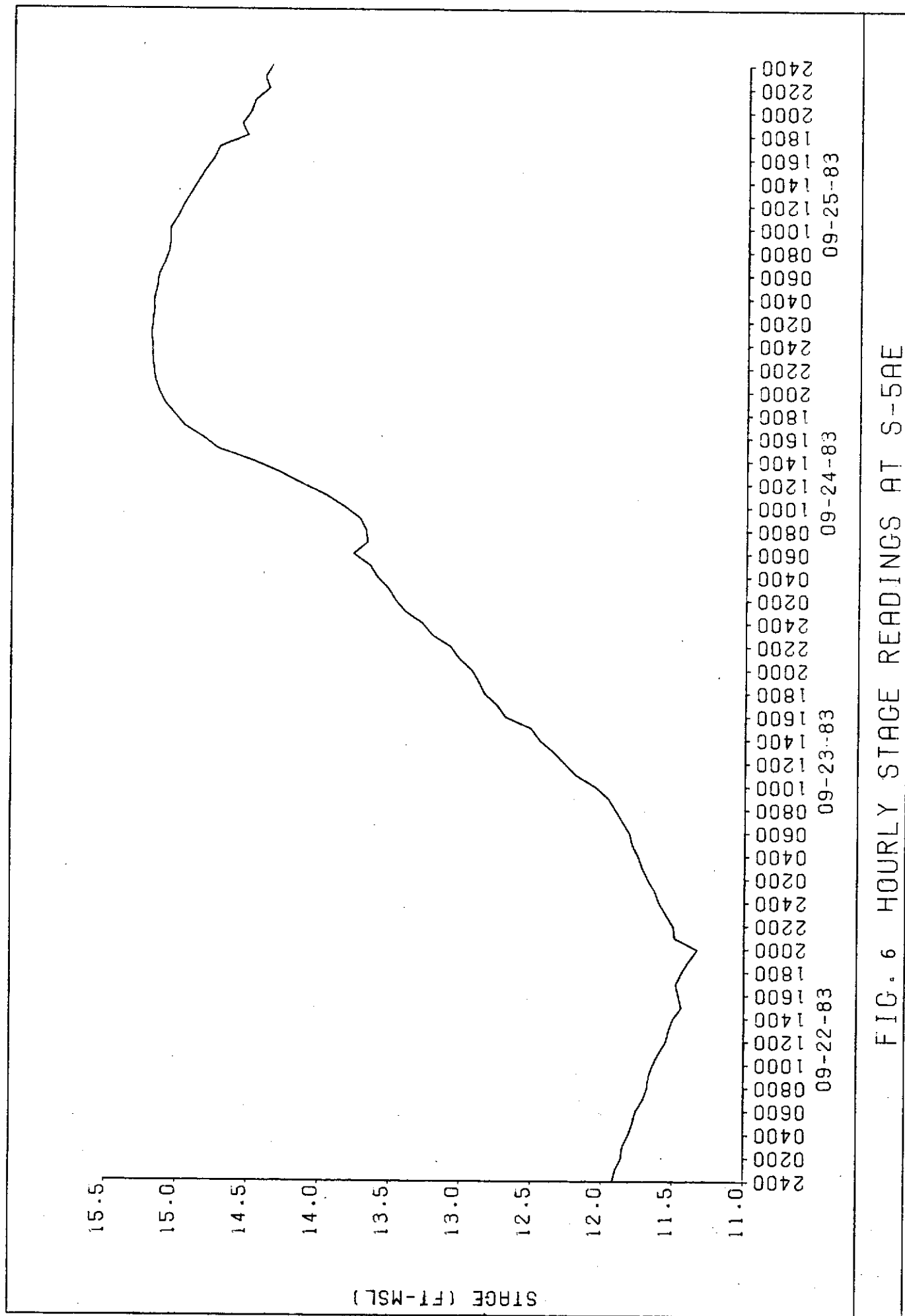
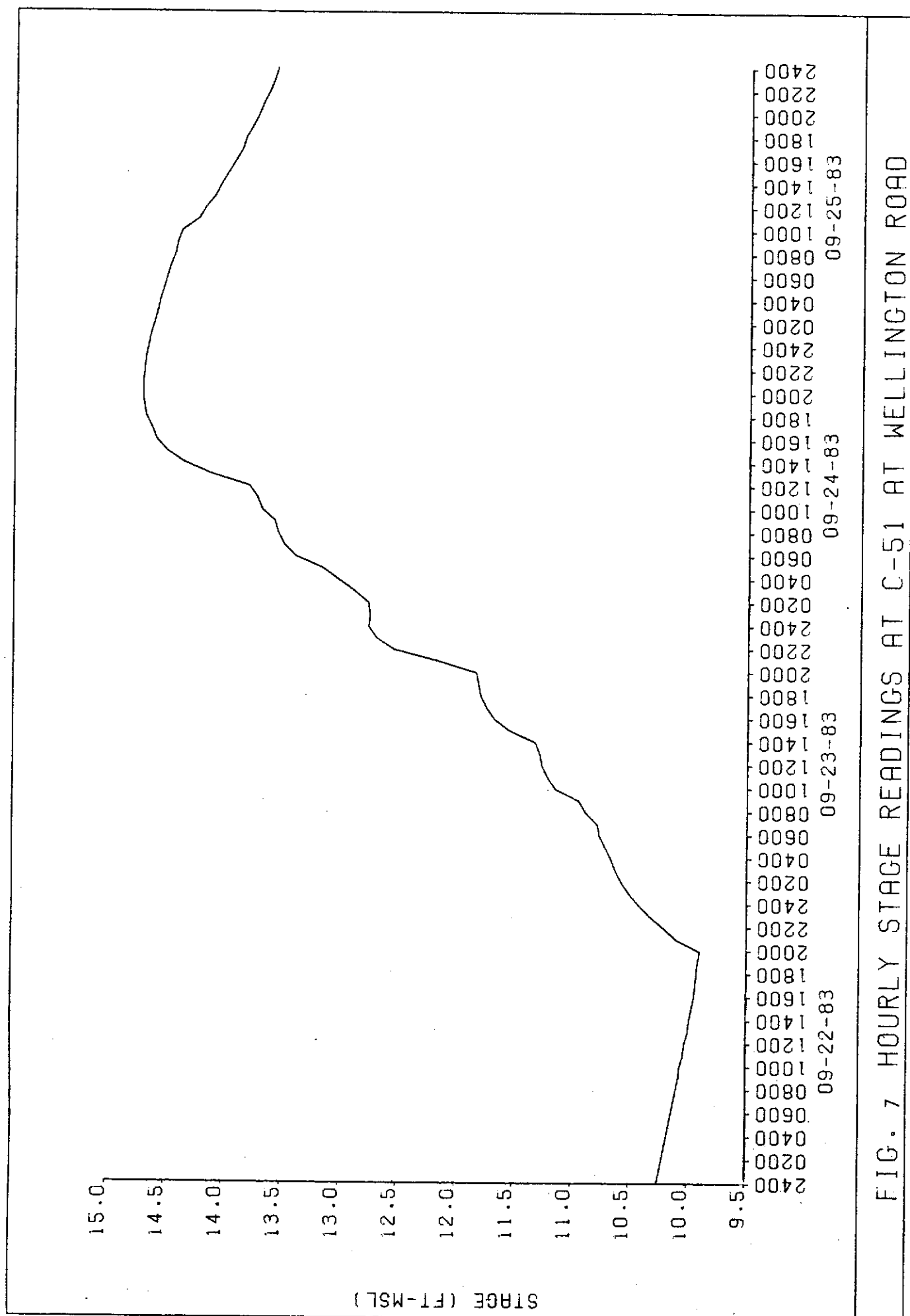


FIG. 6 HOURLY STAGE READINGS AT S-5AE



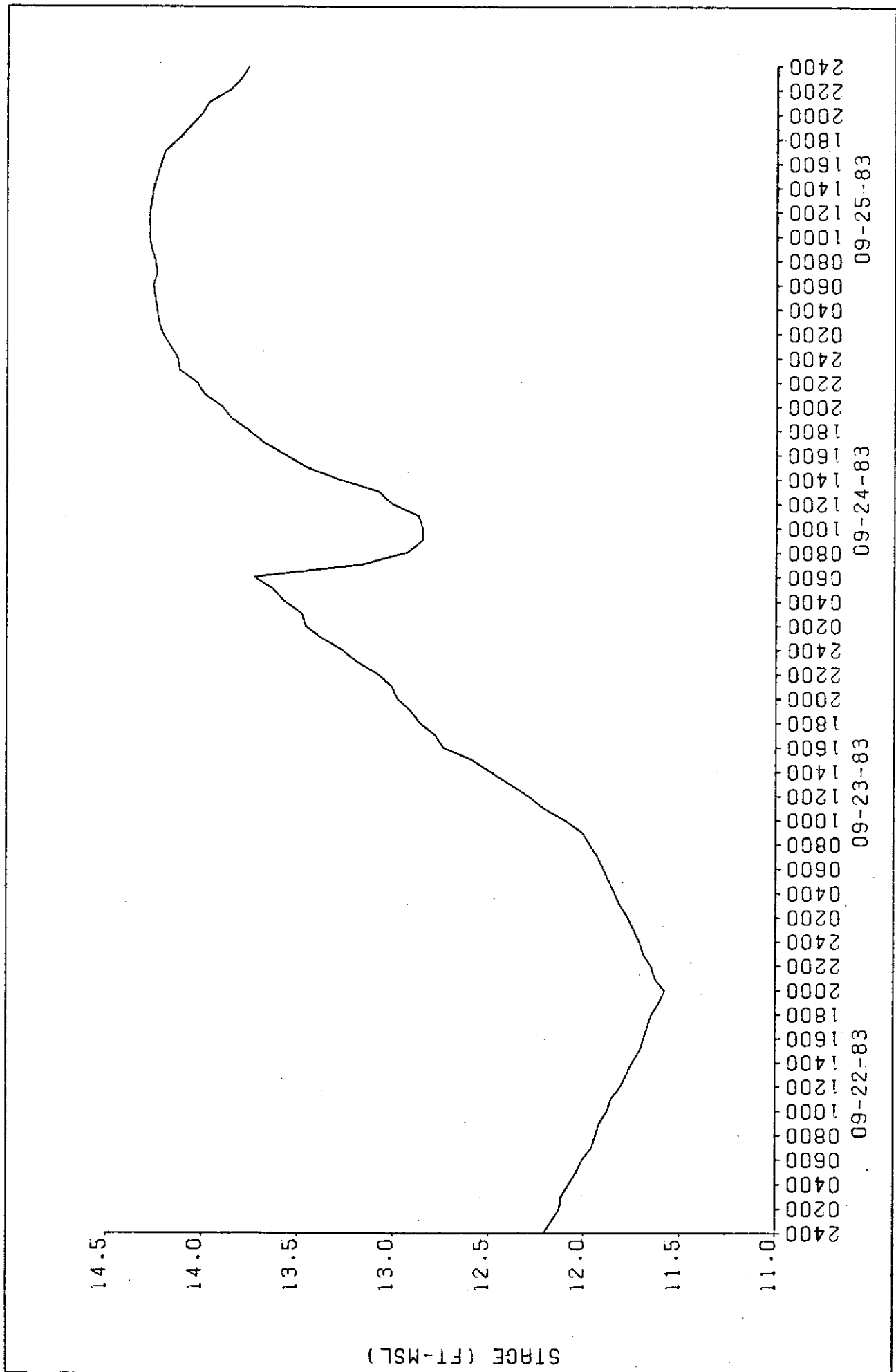
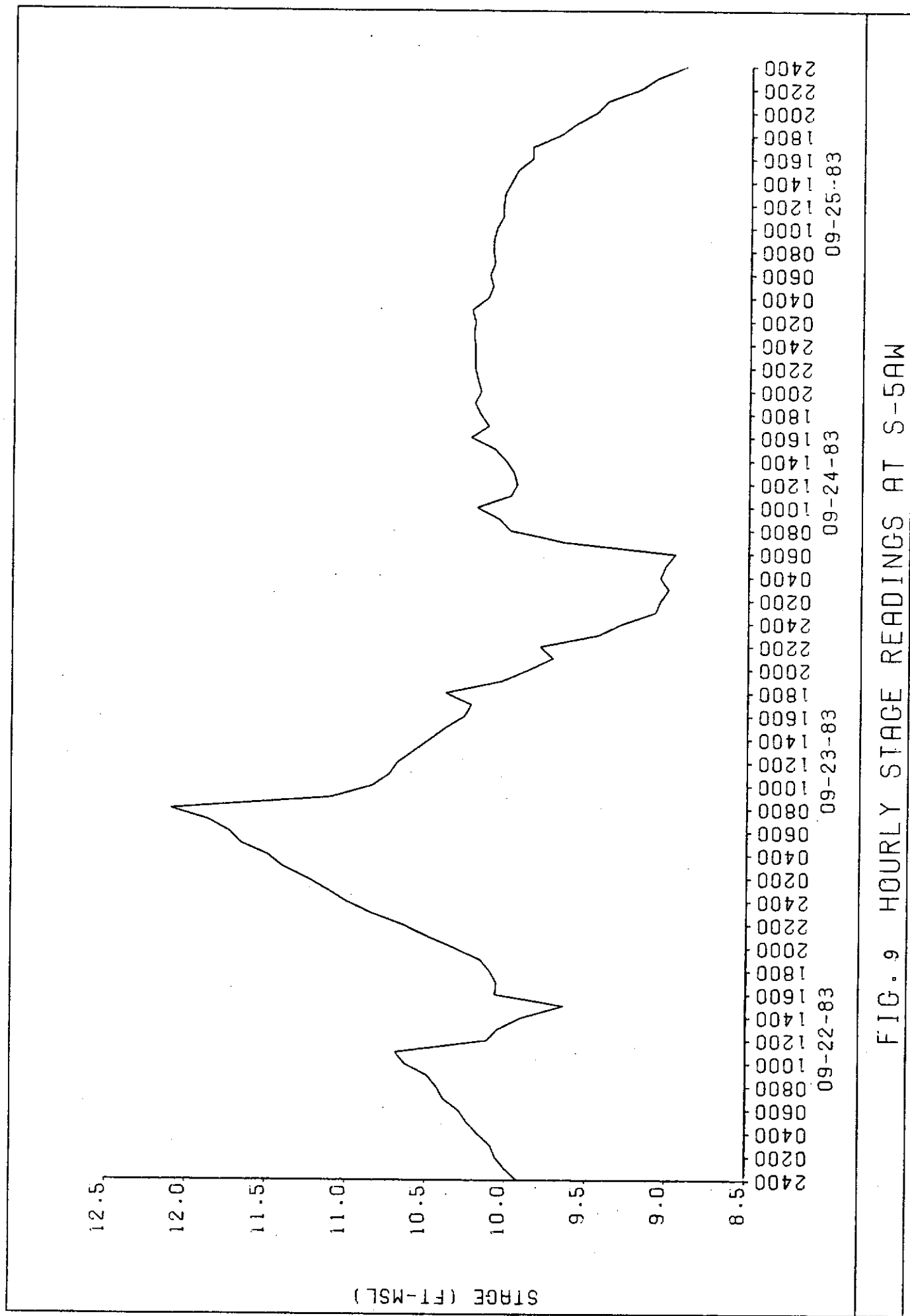
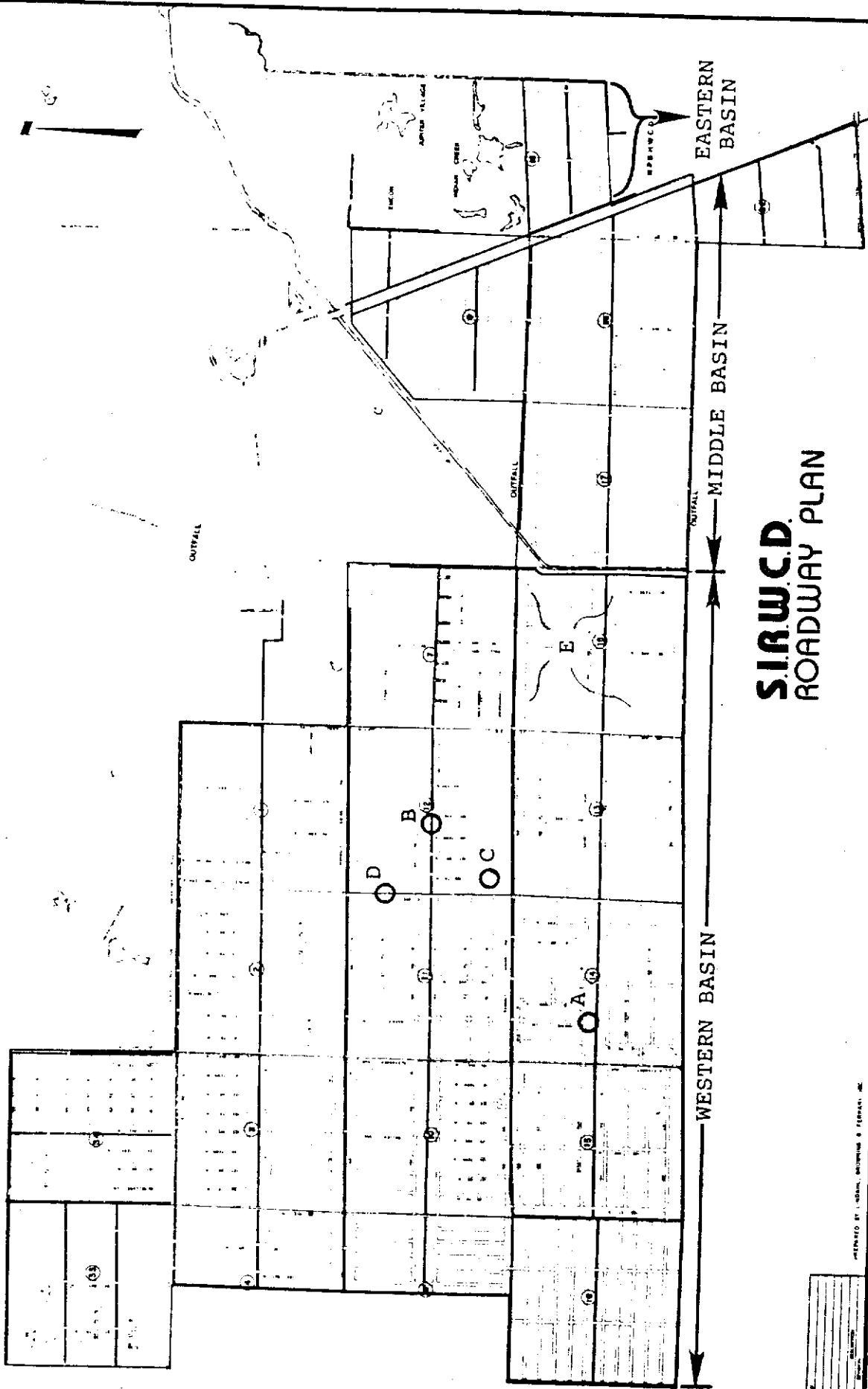


FIG. 8 HOURLY STAGE READINGS AT L8



WEST JUPITER



SIRW.C.D. ROADWAY PLAN

- A - ROAD WASHOUT
- B - ROAD WASHOUT
- C - LOT FLOODING
- D - LOT FLOODING
- E - AREA WITH 18" STANDING WATER

FIGURE 10